FOCUS
On Broadband Wireless Internet Access

Independent, original, in-depth coverage of the trends and technology shaping the BWIA industry

Recipient of Part-15.Org's *2002 Wireless Advocate Of The Year* Award

Steve Stroh, Editor

January 8, 2003 **Issue 2003-01**

In This Issue:

Vivato – Phased Array Antennas + Wi-Fi Clients Could Change *Everything* 1
Editorial – Five Year "Broadband Wireless Is Easy" Countdown Has Begun 6
***FOCUS** On Broadband Wireless Internet Access* Changes Publication From Monthly to Weekly 7
Experts To Debate License-Free Spectrum On Public Benefits 7
FOCUS Receives Prestigious Industry Award By Part-15.Org 10
FCC Proposes License-exempt Use of Television Broadcast Spectrum 11
Events Of Interest To The Broadband Wireless Internet Access Industry 14

ISSN: 1536-7215

FOCUS On Broadband Wireless Internet Access is founded upon the following tenets:

1. Internet technology is becoming the foundation for nearly all communications, commerce, and entertainment services;
2. For Internet access to be truly usable, always-on Broadband Internet access is required;
3. By the end of the first decade of the 21st century, Internet access will be ubiquitous;
4. In the "last mile", wireline-based technologies and systems will generally prove to be insufficient or not cost-effective to provide ubiquitous, always-on, Broadband Internet to most homes and businesses;
5. In the near term, Broadband Wireless Internet Access in all its forms – Sub 11 GHz, Above 11 GHz, Free Space Optics, Ultra Wideband, Licensed, License-exempt has emerged as *the most likely technology* to provide cost-effective, ubiquitous, always-on Broadband Internet Access.

FOCUS** on Broadband Wireless Internet Access* is written in an informal, easy-to-read style, with an emphasis on clear explanations of why a particular company, product, or development in the Broadband Wireless Internet Access industry is significant. Each issue contains a number of *original*, in-depth articles and news stories. ***FOCUS is a just-in-time, short-lead-time publication, using Adobe Acrobat (.pdf) format, and email distribution. ***FOCUS** On Broadband Wireless Internet Access* is published by:

Steve Stroh
P.O. Box 84
Redmond, WA 98073-0084 USA
425-481-0600
steve@strohpub.com
www.strohpub.com

All logos, trademarks, etc. referenced in *FOCUS* are the property of their respective owners.

Vivato – Phased Array Antennas + Wi-Fi Clients Could Change *Everything*
(In Broadband Wireless Internet Access)

On November 4, 2002, Vivato (formerly Mabuhay Networks) uncloaked from stealth mode in San Francisco, CA. While Vivato calls their product a "Wi-Fi Switch", it is essentially an 802.11b / Wi-Fi Access Point mated to a sophisticated Phased Array Antenna (PAA) system.

The Vivato system can provide Wi-Fi coverage of a building floor, an entire building, or outdoors up to four miles (each coverage pattern is a different product). The stated ranges are connections with *conventional Wi-Fi client devices* – PC cards inserted in laptops, Wi-Fi devices connected to desktop computers with Universal Serial Bus (USB), or, increasingly, Personal Digital Assistants (PDAs) equipped with Wi-Fi.

Vivato's accomplishment is a *seminal breakthrough* in the Broadband Wireless Internet

A Note on the Format of *FOCUS*:

While ***FOCUS*** is delivered electronically (via email), in electronic (Adobe Acrobat .pdf) format, the *layout* of ***FOCUS*** is optimized for hardcopy- it is assumed that ***FOCUS*** will be printed out for reading. In essence, ***FOCUS*** is a print newsletter, delivered electronically, and as such, columns and other "print" layout techniques are used. My research to date has indicated that a "print" format for ***FOCUS*** would be most popular. If you have a strong preference for a "linear" layout for electronic-only reading, please let me know. If there is sufficient demand, ***FOCUS*** could be made available in "print reading" and "electronic reading" versions. Also, if your preference is for text-only (no .pdf), please let me know that also.

Access industry. A Vivato system makes it possible to provide unprecedented Wi-Fi coverage and encompass far greater numbers of potential users than from conventional 802.11b / Wi-Fi Access Points. Vivato's system considerably exceeds the capability of "enhanced" Access Points intended for outdoor zone coverage that use higher-power transmitters, focused antennas, and very sensitive receivers.

Missing Piece Vivato's system is the missing piece in large scale Wi-Fi deployments such as are envisioned by the recent announcement of Cometa Networks, formed by IBM, Intel, and AT&T (note – *not* AT&T Wireless) with the stated goal of establishing "tens of thousands of access points" in the fifty largest US cities "by 2004".

The "Cometa Problem"

The main reason for Wi-Fi's surging popularity among consumers and small business is that it's easy to install and use, relatively inexpensive, and fast. In individual locations, Wi-Fi Access Points are small, unobtrusive, easy to install, the range limitations are adequate to cover households, and for light usage, a business-class Digital Subscriber Line (DSL) Internet connection is adequate. But, as many enterprises such as large corporate campuses, colleges, and service providers such as (bankrupted) MobileStar have discovered, Wi-Fi is anything but easy to deploy on a large scale. In a large scale deployment, where coverage areas are stated (as a certainty), the attributes of Wi-Fi Access Points work against large scale deployments:

- Multiple locations for siting Wi-Fi Access Points must be found.
- Even worse, multiple locations must be negotiated.
- Internet connections must be arranged. Because of varying equipment standards, spotty availability, and lack of manageability, DSL is often not an attractive option for a large scale deployment where the fewer the variants that installers have to be trained for, the faster the installations can be accomplished. For that reason, T-1 lines are the preferred method of connection for commercial Wi-Fi access points. (In a campus, presumably there is adequate Ethernet infrastructure to allow connection of the Wi-Fi AP.) The collective cost of multiple wireline T-1's (typical cost - $500/month) to supply Internet connectivity is one of the primary reasons that analysts have stated that the business case is very weak for businesses based on widespread deployment of Wireless HotSpots.

Vivato's system deals with these issues handily:

- To provide coverage of an area, only a single location must be found and negotiated, and unlike a conventional AP with its very limited range, the Vivato unit's greater range allows considerable flexibility in where it can be located; often on the exterior of a commercial building.
- Internet connectivity is still an issue (even greater – see below), but there are far fewer Internet connections needed and that, along with the flexibility of location of the Vivato unit, allows the deployer much greater flexibility of Internet connectivity options (and costs).
- While the disadvantages and advantages listed above can also be ascribed to "high power" Wi-Fi Access Points, such devices suffer badly from "congestion" in urban areas. Their signals can easily be interfered with. In contrast, Vivato's system can deal with such interference by frequency flexibility and if necessary active interference cancellation. Just as a "beam can be formed" by a Phased Array Antenna (PAA), a "null" can be formed and a source of interference *actively* rejected.

Active Interference Cancellation

The ability to actively "null out" potential interference is a key attribute of the Vivato system. What makes conventional Wi-Fi usable in an urban area is its highly-limited range, so that the three non-overlapping 802.11b / Wi-Fi channels in the 2.4 GHz band can be reused. It's not enough for Vivato to enhance the usable range of conventional Wi-Fi devices, because it is then receiving signals not only from the Wi-Fi devices it wants to receive (customers of the service for which the Vivato system is deployed), but it will also receive signals from *all other active Wi-Fi devices in the coverage area.*

To some extent, such unwanted signals can be simply discarded (received, but not responded to), but there will be numerous cases with every high-profile Wi-Fi system where such passive rejection isn't adequate. In such cases, the reception of a non-desired Wi-Fi system in the coverage area of a Vivato system can be *actively* rejected – just as Phased Array Antennas can "form a beam", so can a PAA "form a null" – effectively "notching out" the offending transmissions.

Control Of The Environment

While range extension and active unwanted signal rejection are critical elements of "Wide Area Wi-Fi deployment", they're by far not the only ones. Because 802.11b / Wi-Fi has only three available non-overlapping channels in the 2.4 GHz band, some way must be found to dramatically increase frequency reuse. Again, the intended design of 802.11b / Wi-Fi deals with this issue by severely truncating the range of a typical Wi-Fi Access Point and client devices – a few hundred feet at most.

Vivato's approach to dealing with the frequency reuse issue almost as a byproduct of its PAA system – each "beam that is formed" can be a different channel – potentially unlimited frequency reuse.

Elements of Scalability

It is this combination of capabilities – range extension, active interference rejection, frequency reuse, and others such as "reduced number of elements to manage" that make Vivato's system so highly scalable.

Opens The Market For High Bandwidth

One factor largely unmentioned in discussion of Vivato's system is that for it to provide optimal service to each user, it will require much greater bandwidth to effectively provide high-speed Internet service to all its potential users. For example, if a Vivato system is capable of providing connections to 150 simultaneous users in its coverage area, each user will typically "need" the equivalent of 1 Mbps of Internet connectivity for a satisfactory experience (equivalent to what is encountered on a conventional Access Point with a limited number of users, sharing a 1.544 Mbps wireline T-1 line.) 150 users x 1 Mbps = 150 Mbps of Internet bandwidth required per Vivato antenna. Fortunately, users don't need continuous, dedicated bandwidth, so considerable "oversubscription" still provides an adequate user experience (and is the financial basis of all Internet Service Providers). However, a severe "oversubscription" such as sourcing a Vivato antenna with one, or even a few T-1 circuits simply won't be adequate except in the very short term as a user base is initially established.

Thus, deployment of Vivato systems creates a near-immediate demand for higher-bandwidth Internet connections. A 10 Mbps connection is probably adequate to start, scaling up to perhaps 5 such connections, or a single 50 Mbps connection.

At such speeds, Broadband Wireless systems become *highly* competitive with wireline systems… good thing, because if wireline 1.544 Mbps T-1 circuits are considered expensive… wireless 45 Mbps T-3 circuits are considered obscenely expensive. It is expected that a very competitive market will emerge for "very high bandwidth" backhaul Internet connectivity to emerge – competitive because barriers to entry are low and carriers with licensed spectrum very much *do not* have such a market "to themselves", due to the emergence of cost-effective, highly-robust license-exempt systems using not only

RF, but increasingly, Free Space Optical (FSO) systems.

Rapid Evolution Of The Wi-Fi Market

The Wi-Fi market is rapidly evolving. 802.11a devices are now shipping in quantity, using the more robust modulation technique of Orthogonal Frequency Division Multiplexing (OFDM), operating at speeds up to 54 Mbps in the 5 GHz band. The 802.11g standard, offering OFDM and 54 Mbps in the 2.4 GHz band is on track to be officially ratified in early 2003, and devices "compliant with the 802.11g draft standard" are already shipping. "Dual band" chipsets have been announced and some dual band hardware has begun to ship. It's expected that the bulk of the Wi-Fi market will quickly shift to "tri-mode" devices, capable of seamless operation between 802.11b, a, or g (802.11b/a/g) Access Points.

The various security shortcomings in 802.11b (and 802.11a and 802.11g) have been addressed, with all 802.11b / 802.11a / 802.11g units shipping in 2H 2003 will incorporate these fixes, with a slightly-less robust security solution made available for many existing systems. Vivato's technology scales quite well to address these changes, especially the move to 5 GHz, where the physics of Phased Array Antenna technology are even more favorable.

Disruptive Technology

It's ironic that the Broadband Wireless Internet Access industry – itself a "Disruptive Technology[1]" is subject to Vivato's system as a Disruptive Technology. But as Vivato's systems become more widely deployed, and cost-reduced and improved-performance derivations emerge, Vivato's system will likely begin to displace existing Broadband Wireless Internet Access products. The reasons are basic:

- Wi-Fi client devices are already commodity devices; inexpensive, ubiquitous, and increasingly, built-in
- Wi-Fi client devices can and usually are purchased and installed by the end user, if not built-in to the device
- Vivato's system (outdoor version) makes possible a range of as much as several miles between a base station and a Wi-Fi client device, and at shorter ranges, makes possible "Non-Line-Of-Sight such as through exterior walls (that typically severely attenuate Wi-Fi signals). Such performance is the goal of any number of Broadband Wireless Internet Access products currently being offered. With users purchasing and installing the Customer Premise Equipment (CPE)… how can a Service Provider justify the use of proprietary CPE? More importantly, how can a Service Provider using proprietary CPE be completive against a Service Provider whose CPE has already been purchased and installed by *potential* users?

The list of Broadband Wireless Internet Access vendors who are thus threatened by Vivato's system is long:

- Most at risk are companies whose products are exclusively or largely developed for ITFS/MMDS spectrum at 2.5-2.7 GHz and WCS spectrum at 2.3 GHz such as NextNet Wireless, IPWireless, Navini Networks, SOMA Networks, and BeamReach Networks. To make an effective business case, ITFS/MMDS spectrum owners required system vendors to develop systems that are user-installable and not require an outdoor antenna. To meet these daunting requirements, vendors were forced to develop new technologies, with correspondingly high cost of base stations and Customer Premise Equipment units. Vivato's system achieves the same system design goals, but using conventional, inexpensive Wi-Fi devices as CPE. Thus, there is little compelling advantage for Service Providers to use ITFS/MMDS spectrum, and those who do so are at a considerable disadvantage to Service Providers using Vivato's system and corresponding economies of scale and CPE cost of Wi-Fi devices as CPE.

---

[1] From *The Innovator's Dilemma* by Clayton Christensen

- ArrayComm's iBurst product line is threatened by Vivato. iBurst offers approximately 1 Mbps while portable (not full mobility such as automotive speeds). An outdoor Vivato system can easily achieve user density and performance equivalent to iBurst, but without the requirement of proprietary client hardware. ArrayComm's core market of non-stationary, high-bandwidth Internet users will increasingly be already equipped for use of Wi-Fi, and thus the sale of an additional client device will be difficult.
- Aerie Networks' Ricochet system, developed and originally deployed by Metricom, is similarly faces a challenge similar to ArrayComm's iBurst. While Ricochet can achieve full mobility and some networks have been deployed and reactivated, it is relatively low speed and requires proprietary hardware.
- Because of the breadth of its product line, Alvarion will be somewhat insulated from the disruptive technology effect of Vivato's systems, but Alvarion will likely experience loss of sales from key portions of its customer base – those conducting large, dense deployments of wireless CPE such as the SpeedNet system in Japan. Alvarion equipment was selected for SpeedNet because Wi-Fi equipment, conventionally deployed (high-profile access points) could not scale to meet the requirements of a dense deployment; that's no longer the case with a Vivato system as a base station.

Adapting For Wi-Fi

While many BWIA proprietary product lines will ultimately be rendered uncompetitive by the "Vivato model" (Phased Array Antenna technology, Wi-Fi devices as clients), some vendors may yet rise to the challenge by adapting their Phased Array Antenna technology to the same goal – making it work with Wi-Fi devices instead of proprietary client devices. ArrayComm's iBurst and BeamReach Networks' BeamPlex systems could potentially offer Vivato some challenge. ArrayComm's iBurst PAA technology is tuned for "non-stationary" use – the client device is expected to move regularly and if not moving too fast, continuous connectivity can be maintained. Vivato will be focused for some time cost-reducing and ramping production of its systems, thus a niche that ArrayComm may be able to exploit. BeamReach Networks' BeamPlex technology is impressive in that its focused coverage area is a particular zone, not "merely" an entire sector radiating from a base station as is the case with the majority of Phased Array Antenna technology. Thus, BeamReach Networks may be able to exploit a gap in Vivato's product line.

Vivato Competition Inevitable

Whether ArrayComm, BeamReach Networks, and others are able to adapt their existing Phased Array Antenna technology to meet the challenge from Vivato, the model of using PAA technology to compensate for the various deficiencies in Wi-Fi technologies when it is used in a wide area network deployment is so compelling that competition is inevitable. As this issue of ***FOCUS*** was being completed, news of the first competitor to Vivato has emerged. On January 7, 2003, California Amplifier announced that it has developed "RASTER - an adaptive digital beamforming smart antenna technology for 802.11 applications." California Amplifier's primary line of business has historically been equipment for use in the ITFS/MMDS 2.5-2.7 GHz band… including the initial development of RASTER. It's notable that California Amplifier is an OEM supplier; thus it's quite possible that RASTER could quickly find its way into other companies' BWIA products.

***Will* It Happen?**

The emergence of Vivato and similar systems such as California Amplifier's RASTER make it inevitable that Wi-Fi devices as clients will rapidly begin to displace systems based on proprietary BWIA technology. The economics and spreading ubiquity of Wi-Fi devices will make winners of those who embrace the trend.

Editorial

Five Year "Broadband Wireless Is Easy" Countdown Has Begun

I've stated on numerous occasions, but don't recall committing to print before now, that at some point in the future, I fully expect *Broadband Wireless Internet Access to become about as exciting and challenging as Ethernet.* With the emergence of Vivato (see previous story) as a catalyst, I declare that the aforementioned "five year countdown" commenced on November 4, 2002.

My reference to Ethernet is intended to be high praise, as Ethernet has evolved from "yet another wire-based networking system" to be the only such system of any consequence. Ethernet has so thoroughly evolved that it is trivially easy to use to network computers and other devices together that detailed information and specialized knowledge of Ethernet is needed only in a tiny percentage of uses.

By November 4, 2007, much as the case with Ethernet, I fully expect that Broadband Wireless Internet Access technology and systems will have become very commonplace, highly standardized, well-understood, and sufficiently easy to use that little explanation or analysis will be required by the vast majority of those involved. In short, I expect to be out of a job publishing ***FOCUS***.

To me, this trend has been clear, though not the timeline. BWIA technology has been evolving in many different directions – new modulation techniques, new system designs, new capabilities, new requirements, and new technologies have sent the Broadband Wireless Internet Access industry in a number of different, incompatible directions.

With the emergence of Vivato and others who will offer Wi-Fi products that integrate Phased Array Antenna systems, it's now apparent that, like it or not, Wi-Fi systems will be the catalyst for the rapid coalescence of the BWIA industry. Wi-Fi systems are now capable of addressing many market segments which previously required proprietary technology. Proprietary technology will be "driven" to seek out smaller niches that Wi-Fi cannot or will not address. Those smaller market segments will drive consolidation of vendors and technologies. Systems based on 802.16a standards will also begin to address such niches, further driving consolidation, standardization, interoperability, ease of use, and lower prices.

My predictions are that by November 4, 2002,:

- Broadband Wireless Internet Access equipment vendors will be doing more business than they could possibly have imagined five years earlier, as wireline systems are increasingly abandoned for easy-to-upgrade, faster, and less-expensive Broadband Wireless Internet Access services.
- BWIA Service Providers have proliferated to offer highly-competitive Broadband Internet Access in major metropolitan areas, and reasonably competitive, but far more ubiquitous Broadband Internet Access in secondary and rural markets than was ever (or could have ever) been the case with wireline providers
- Users and customers will be well serviced by the vast advances of technology and usability applied to Broadband Wireless Internet Access systems. They'll have far greater selection of providers and differentiated services, at lower prices, than was (or could have ever) been the case with wireline providers.

All of this is *not* to say that the next five years will be boring and uneventful. Far from it; the next five years of evolution in the Broadband Wireless Internet Access industry will be its most exciting era so far! That leaves ample room for insightful, in-depth analysis and coverage from publications such as ***FOCUS***.

* * *

***FOCUS On Broadband Wireless Internet Access*:**

`www.strohpub.com/focus.htm`

FOCUS On Broadband Wireless Internet Access Changes Publication From Monthly to Weekly

Beginning with this issue of ***FOCUS***, the frequency of publication has officially changed from Monthly to Weekly.

Publication of ***FOCUS*** has been a process of discovery, blessed by doing some things right, marred by doing many things wrong, and several changes of direction and "formative experiences." The primary problem I faced with ***FOCUS*** is that my ambitions for insightful, in-depth coverage of the Broadband Wireless Internet Access industry significantly exceeded my capabilities when attempting to publish a multi-article newsletter on a monthly basis. In short, monthly publication of ***FOCUS*** became trapped between the many, often rapid-fire developments that deserved to be covered… and the reality of the rapid obsolescence of that information by the time it could reach the readers some weeks afterwards.

After studying a number of successful newsletters, it became apparent that what I was trying to produce in ***FOCUS*** was a magazine… a daunting challenge with a staff of one.

In redirecting ***FOCUS*** into a weekly publication, ***FOCUS*** will now include one or at most two in-depth articles, and include brief, but broader coverage of developments in the Broadband Wireless Internet Access industry. As discussed in this issue's Editorial (which will not appear in each issue of ***FOCUS***), 2003 will likely be an unprecedented period of rapid evolution for the Broadband Wireless Internet Access industry.

For at least the few issues of 2003, ***FOCUS*** will be published biweekly as processes and deadlines are reoriented towards weekly publication. A full year of ***FOCUS*** will be 44 issues annually, allowing for vacations, holidays, and travel (such as next week's WCA Technical Symposium and Business Expo, to which one of the next few issues of ***FOCUS*** will be largely devoted.) Subscribers will receive individualized explanations of conversions between their original (monthly) subscription and the new publication schedule. The subscription conversion will be generous, in gratitude for the fantastic patience exhibited by ***FOCUS*** subscribers.

* * *

Experts To Debate License-Free Spectrum On Public Benefits

Excerpted from the Wireless Communications Association's *License Exempt Alliance (LEA) Report* of December 3, 2002

The kind of regulation (or regulation reform) that most helps license exempt users deploy broadband – one of the hottest topics in communications policy in top regulatory circles – will be debated by two noted advocates on Jan. 13, the opening day of the ***Symposium***. Expected to take rather different views are two witnesses who were invited to testify at the historic FCC Spectrum Policy Task Force workshop series this summer, whose goal was to help the FCC reform U.S. spectrum policy. Taking the position that license-free spectrum helps advance the interests of consumers of residential and business services is independent technology writer Steve Stroh, whose numerous publishing outlets include the newsletter ***FOCUS On Broadband Wireless Internet*** (www.strohpub.com). A member of the LEA Executive Committee, his other recent speaking engagements include giving the opening keynote addresses at ***WISPCON II*** in Chicago in October and the keynote address for ***ISPCON*** in Las Vegas last month. Taking a rather different view underscoring the value of spectrum rights in encouraging carriers to invest in new networks will be Dr. Thomas Hazlett, a Senior Fellow at the Manhattan Institute for Policy Research and former FCC Chief Economist. He also is a prolific and influential commentator, whose outlets range from scholarly debates in learned periodicals to frequent op-ed columns at the highest level of influence (frequently in the **Wall Street Journal**, for example). The specific topic is: "Do Strong Spectrum Property Rights Help Consumers?" Don't miss this world-class debate in San Jose that is of vital interest to the license exempt community.

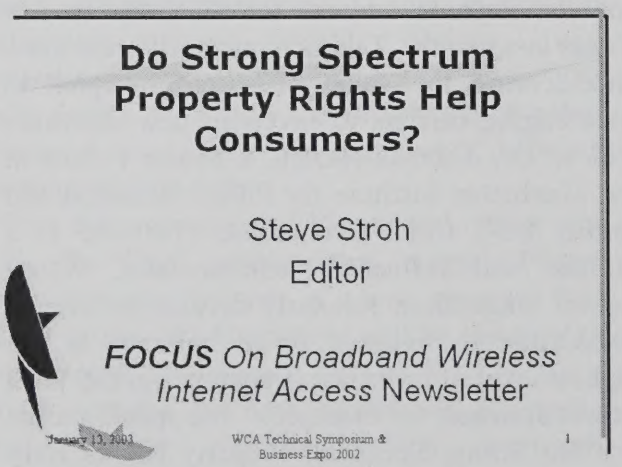
Editor's notes:

The subsequent issue of *LEA Report* offered this update:

> To clarify an item last week, the Jan. 13 ***Symposium*** panel by spectrum policy experts Steve Stroh and Dr. Thomas Hazlett will be more of a vigorous discussion than a formal debate.

The update came after a brief email exchange between Hazlett and I, copied to the WCA, about the format of our session. Hazlett's views on spectrum usage have considerable overlap with mine. I was lucky enough to meet Dr. Hazlett when we were both panelists on the FCC Spectrum Policy Task Force's "Spectrum Rights and Responsibilities" panel. It's amusing that while I advocate the sharing of television broadcast spectrum for communications use, Hazlett advocates abolishing television broadcasting entirely, offering the persuasive argument that in excess of 80% of television viewers pay a fee to avoid television broadcasts (by subscribing to cable television or satellite television.)

Following are the PowerPoint slides that I will present at next week's WCA 2003 Technical Symposium and Business Expo.

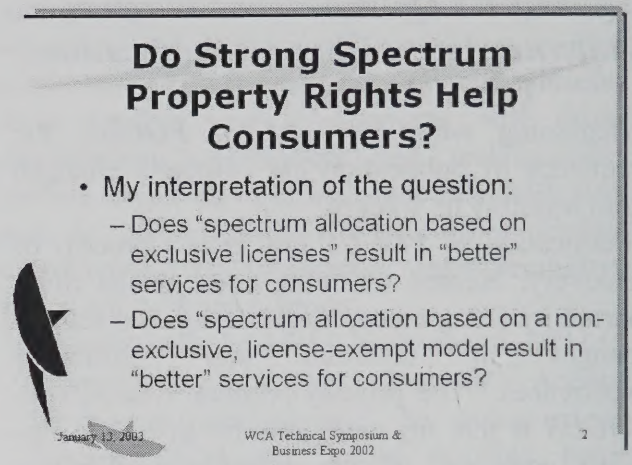


Do Strong Spectrum Property Rights Help Consumers?

Steve Stroh
Editor

FOCUS On Broadband Wireless *Internet Access* Newsletter

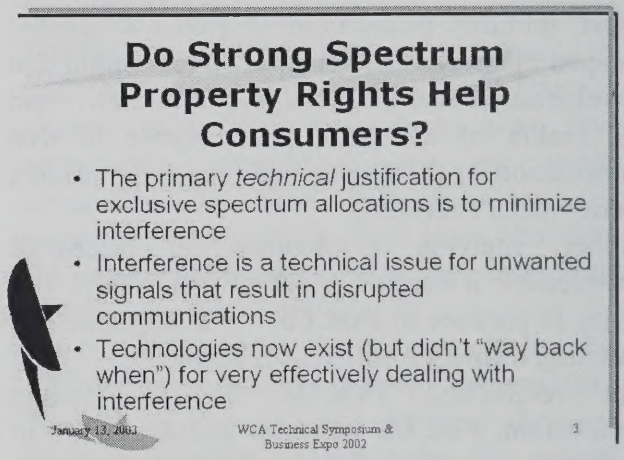
January 13, 2003 WCA Technical Symposium & Business Expo 2002 1



Do Strong Spectrum Property Rights Help Consumers?

- My interpretation of the question:
  - Does "spectrum allocation based on exclusive licenses" result in "better" services for consumers?
  - Does "spectrum allocation based on a non-exclusive, license-exempt model result in "better" services for consumers?

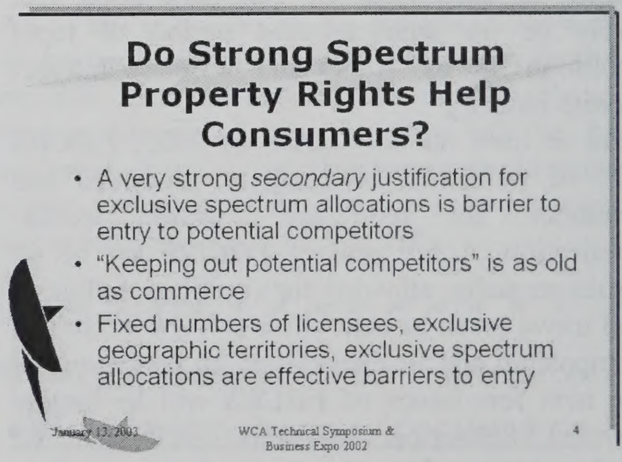
January 13, 2003 WCA Technical Symposium & Business Expo 2002 2



Do Strong Spectrum Property Rights Help Consumers?

- The primary *technical* justification for exclusive spectrum allocations is to minimize interference
- Interference is a technical issue for unwanted signals that result in disrupted communications
- Technologies now exist (but didn't "way back when") for very effectively dealing with interference

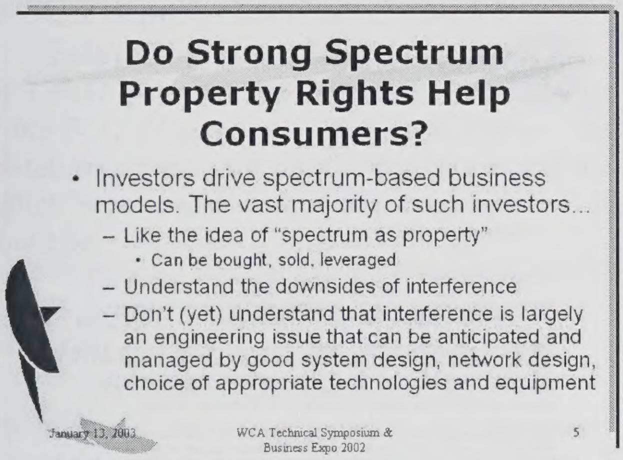
January 13, 2003 WCA Technical Symposium & Business Expo 2002 3



Do Strong Spectrum Property Rights Help Consumers?

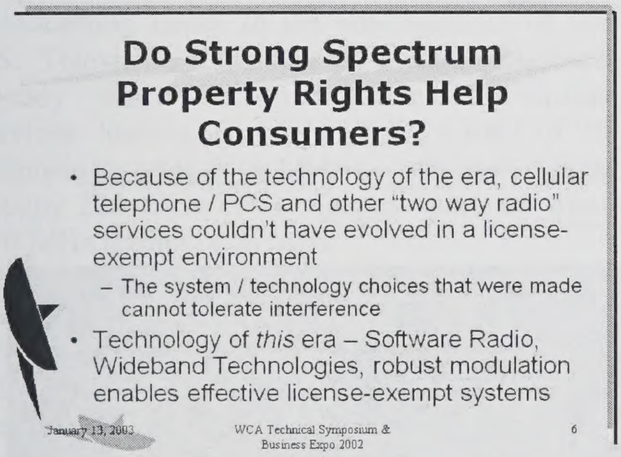
- A very strong *secondary* justification for exclusive spectrum allocations is barrier to entry to potential competitors
- "Keeping out potential competitors" is as old as commerce
- Fixed numbers of licensees, exclusive geographic territories, exclusive spectrum allocations are effective barriers to entry

January 13, 2003 WCA Technical Symposium & Business Expo 2002 4



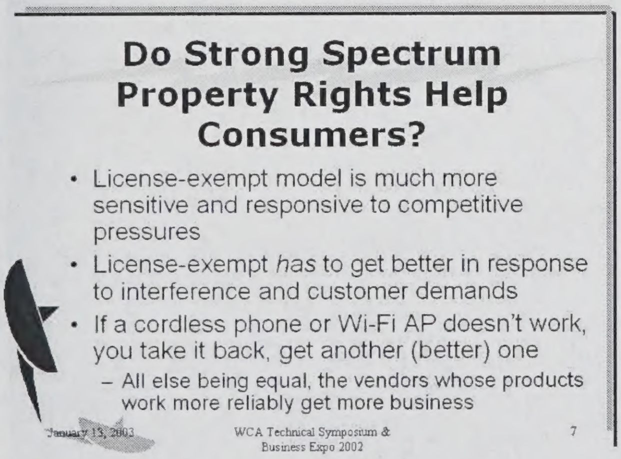
Do Strong Spectrum Property Rights Help Consumers?

- Investors drive spectrum-based business models. The vast majority of such investors…
  - Like the idea of "spectrum as property"
    - Can be bought, sold, leveraged
  - Understand the downsides of interference
  - Don't (yet) understand that interference is largely an engineering issue that can be anticipated and managed by good system design, network design, choice of appropriate technologies and equipment



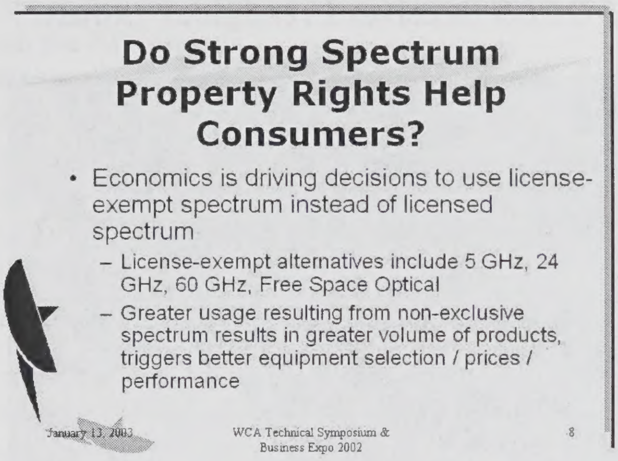
Do Strong Spectrum Property Rights Help Consumers?

- Because of the technology of the era, cellular telephone / PCS and other "two way radio" services couldn't have evolved in a license-exempt environment
  - The system / technology choices that were made cannot tolerate interference
- Technology of *this* era – Software Radio, Wideband Technologies, robust modulation enables effective license-exempt systems



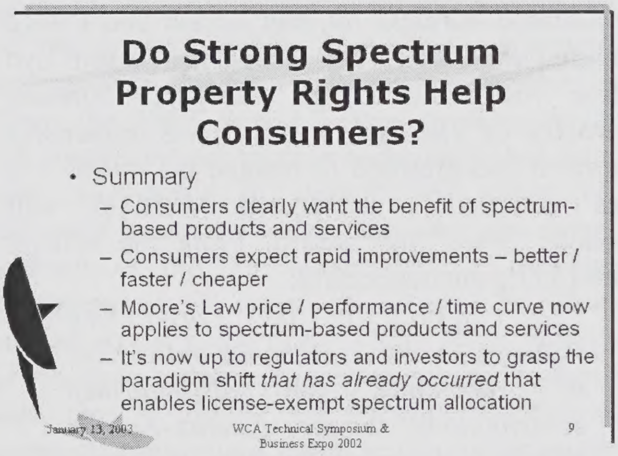
Do Strong Spectrum Property Rights Help Consumers?

- License-exempt model is much more sensitive and responsive to competitive pressures
- License-exempt *has* to get better in response to interference and customer demands
- If a cordless phone or Wi-Fi AP doesn't work, you take it back, get another (better) one
  - All else being equal, the vendors whose products work more reliably get more business



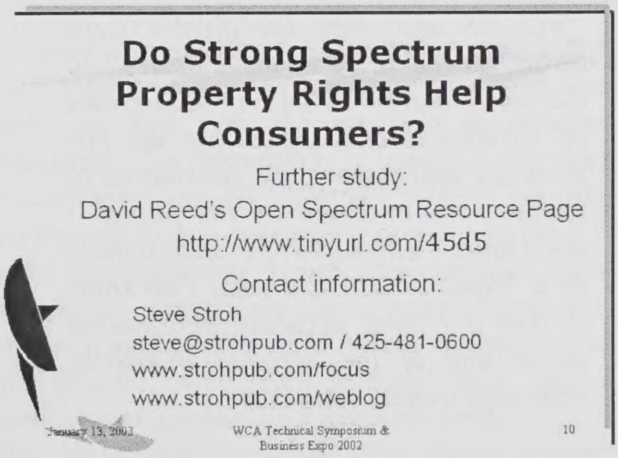
Do Strong Spectrum Property Rights Help Consumers?

- Economics is driving decisions to use license-exempt spectrum instead of licensed spectrum
  - License-exempt alternatives include 5 GHz, 24 GHz, 60 GHz, Free Space Optical
  - Greater usage resulting from non-exclusive spectrum results in greater volume of products, triggers better equipment selection / prices / performance



Do Strong Spectrum Property Rights Help Consumers?

- Summary
  - Consumers clearly want the benefit of spectrum-based products and services
  - Consumers expect rapid improvements – better / faster / cheaper
  - Moore's Law price / performance / time curve now applies to spectrum-based products and services
  - It's now up to regulators and investors to grasp the paradigm shift *that has already occurred* that enables license-exempt spectrum allocation



Do Strong Spectrum Property Rights Help Consumers?

Further study:

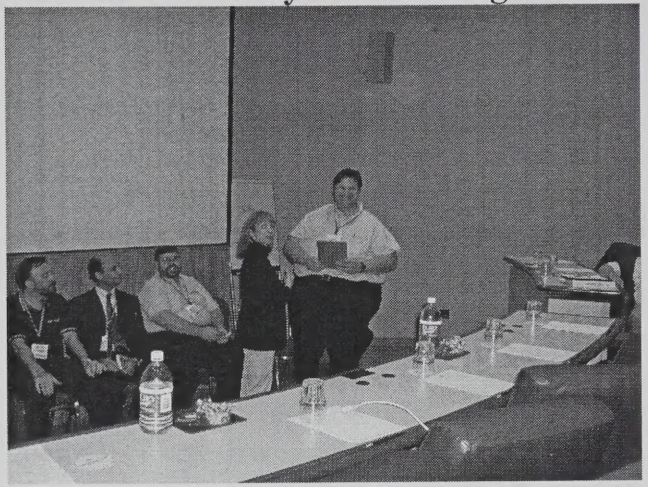
David Reed's Open Spectrum Resource Page

http://www.tinyurl.com/45d5

Contact information:

Steve Stroh
steve@strohpub.com / 425-481-0600
www.strohpub.com/focus
www.strohpub.com/weblog

FOCUS Receives Prestigious Industry Award By Part-15.Org

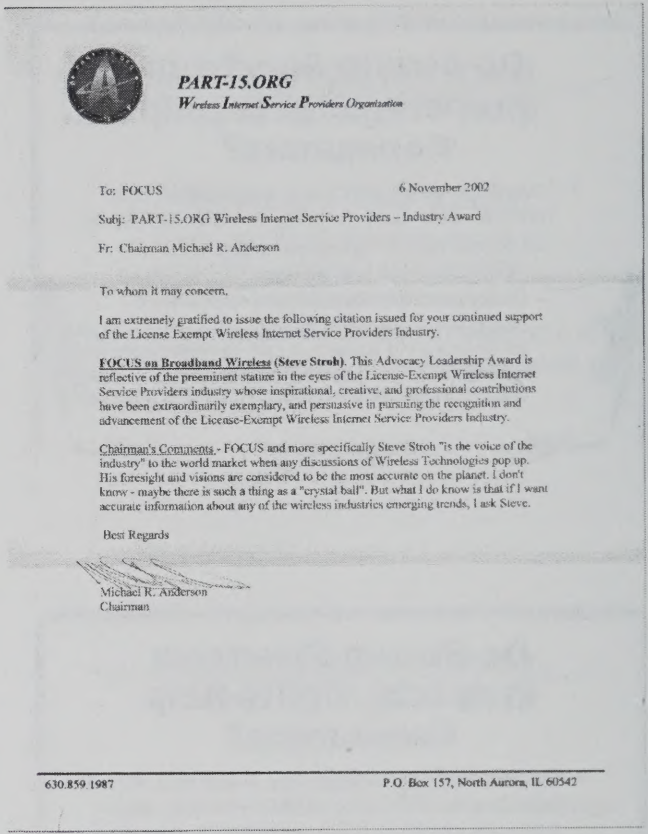


On Wednesday, October 9, 2002, ***FOCUS** On Broadband Wireless Internet Access* and I were honored by Part-15.Org Vice-Chairperson Lyn Kline with Part-15.Org's inaugural *Wireless Advocate Of The Year* award. I was immensely humbled and gratified to receive the award – it was completely unexpected. ***FOCUS*** will proudly "wear" this award. From the official Part-15.Org announcement:

> *The purpose of the Part-15.Org Industry Awards is to honor individuals or companies for distinguished contributions to the License-Exempt Wireless Internet Service Providers Industry.*

Chairman's comments, excerpted from the award letter:

> *FOCUS and more specifically Steve Stroh "is the voice of the industry" to the world market when any discussions of Wireless Technologies pop up. His foresight and visions are considered to be the most accurate on the planet. I don't know - maybe there is such a thing as a "crystal ball". But what I do know is that if I want accurate information about any of the wireless industries emerging trends, I ask Steve.*



PART-15.ORG
Wireless Internet Service Providers Organization

To: FOCUS 6 November 2002

Subj: PART-15.ORG Wireless Internet Service Providers – Industry Award

Fr: Chairman Michael R. Anderson

To whom it may concern,

I am extremely gratified to issue the following citation issued for your continued support of the License Exempt Wireless Internet Service Providers Industry.

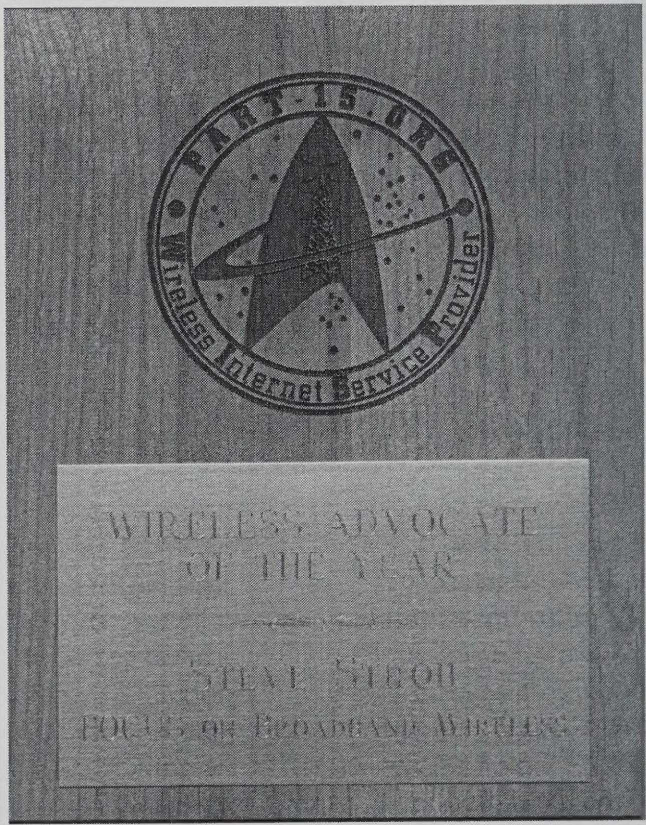
FOCUS on Broadband Wireless (Steve Stroh). This Advocacy Leadership Award is reflective of the preeminent stature in the eyes of the License-Exempt Wireless Internet Service Providers industry whose inspirational, creative, and professional contributions have been extraordinarily exemplary, and persuasive in pursuing the recognition and advancement of the License-Exempt Wireless Internet Service Providers Industry.

Chairman's Comments - FOCUS and more specifically Steve Stroh "is the voice of the industry" to the world market when any discussions of Wireless Technologies pop up. His foresight and visions are considered to be the most accurate on the planet. I don't know - maybe there is such a thing as a "crystal ball". But what I do know is that if I want accurate information about any of the wireless industries emerging trends, I ask Steve.

Best Regards

Michael R. Anderson
Chairman

630.859.1987 P.O. Box 157, North Aurora, IL 60542


PART-15.ORG
Wireless Internet Service Provider
WIRELESS ADVOCATE OF THE YEAR
STEVE STROH
FOCUS on BROADBAND WIRELESS

FCC Proposes License-exempt Use of Television Broadcast Spectrum

If I were permitted to summarize the findings of the FCC's Spectrum Policy Task Force – the written comments, the panel discussions, and the written report, and do so in a single phrase, it would be:

License-exempt spectrum policies
appear to be working so well that
additional spectrum should be allocated
for license-exempt operations.

In both my written comments and my panel testimony to the Spectrum Policy Task Force, I suggested that a particularly egregious waste of valuable spectrum was the largely vacant (both geographically and spectrally) television broadcasting bands in the vast majority of the US. Television Channels 2-13 and 52-69 are already slated for reallocation to various services, leaving Channels 14-51; a total of 38 channels in total @ 6 MHz per channel, which occupy 228 MHz of contiguous spectrum from 470 MHz through 698 MHz.

I suggested one way that television broadcast spectrum could be to include a portion of a television tuner into a broadband radio. If a television signal – digital or analog, were received on a particular channel, then the broadband radio "would not be allowed" to use that particular television channel. I had made this suggestion publicly in my last submitted column for Boardwatch Magazine slated for publication in November 2001, which was run in a severely abbreviated form in the January 2002 issue of Boardwatch. (The story of that column, titled *A Modest Proposal For The Wireless ISP Industry – A "WISP Smart Radio"*, including the column text as originally submitted, was featured in the November/December 2001 issue of ***FOCUS*** *On Broadband Wireless Internet Access*.)

With this background, and obvious interest in the issue, I permitted myself a moment of quiet satisfaction when, on December 20, 2002, the FCC released a Notice of Inquiry (NOI), ET Docket Number 02-380 titled "Additional Spectrum for Unlicensed Devices Below 900 MHz and in the 3 GHz Band". Selected excerpts from the NOI follow:

We are initiating this inquiry to obtain comments from the public on the possibility of permitting unlicensed devices to operate in additional frequency bands. Specifically, we seek comments on the feasibility of allowing unlicensed devices to operate in TV broadcast spectrum at locations and times when spectrum is not being used, and on the technical requirements that would be necessary to ensure that such devices do not cause interference to authorized services operating within the TV broadcast bands

The success of our unlicensed device rules for the ISM bands shows that there could be significant benefits to the economy, businesses and the general public in making additional spectrum available for unlicensed transmitters.

Since the 1989 Part 15 revision, there have been significant advances in technology that may make it feasible to design new types of unlicensed equipment that are able to share spectrum in the TV bands without causing interference to TV broadcast services or other licensed services operating within these bands. For example, advances in computer technology mean that it should be possible to design equipment that would monitor the spectrum to detect frequencies already in use and ensure that transmissions only occur on open frequencies.

Further, equipment can be designed that is frequency agile, with the capability of changing operating frequencies or bandwidth as needed to avoid interference to licensed users. Thus, we believe it may now be possible to operate unlicensed transmitters under certain circumstances on TV channels without causing interference to any authorized services in the TV bands, provided the transmitter complies with appropriate limits on its power, operating frequency and location. These approaches would also protect new TV stations that begin operations on previously vacant channels.

The unused portions of the TV spectrum appear to be a suitable choice for expanded unlicensed operation for several reasons. There is *significant bandwidth available because each TV channel is 6 MHz wide, and multiple vacant channels are generally available in an area to provide greater bandwidth. Allowing unlicensed devices to operate on TV channels that are not being used in a particular area would be a more efficient use of the spectrum. Unlicensed use of this spectrum as opposed to licensed use appears to be appropriate because the operating power levels of unlicensed devices are generally lower than the power levels used in commercial mobile radio services, making it easier for unlicensed devices to identify and operate on unused frequencies without causing interference to authorized services. Further, the frequencies and amount of unused TV spectrum vary from location to location and could change over time as TV stations or other authorized services are added or change frequency, potentially complicating the licensing of commercial services in unused TV spectrum.*

The NOI proceeds by asking a number of highly relevant questions, requires comments to be filed within 75 days, and concludes with statements from the Chairman and three Commissioners.

The Political Dimension

It's said that in Washington DC nearly *everything* has a political dimension, and with lots of encouragement from readers and colleagues, I've slowly learned unless the political dimension of FCC actions are analyzed, the picture is incomplete; NOI ET Docket Number 02-380 is no exception.

One political dimension of 02-380 emerges relatively quickly – the political disaster of a botched, drawn out transition to digital television broadcasting can be associated with the resounding political success and public goodwill of the emergence of Wi-Fi. As in… "the FCC will make more spectrum for Wi-Fi-like systems and services from television broadcasting spectrum."

Another dimension is that in the past, television broadcasters and the National Association of Broadcasters (NAB), arguably one of the three most powerful lobbying organizations in Washington, has to date been strangely silent towards 02-380. Perhaps the broadcasters and NAB have quietly decided to acquiesce to the type of spectrum sharing that 02-380 represents because such license-exempt systems and services are mandated to "get out of the way" when new television broadcasting commences – not only for new broadcasting, but also relay systems and low-power / community television broadcasting. With the eventual loss of Channels 2-13, and the political turmoil that has emerged from "ransom" deals being demanded by television broadcasters operating in the already reallocated "upper and lower 700 MHz band" (formerly Channels 52-59 and 60-69 respectively), the power of television broadcasters is no longer absolute, allowing them to dictate permitted uses of its allocated spectrum. For example, the channels being used in metropolitan areas by two-way radio systems cited in the NOI are permanently removed from television broadcasting use. By comparison, license-exempt usage, on terms of non-interference with television broadcasting, would seem like a relatively benign "spectrum sharing partner."

Yet another non-obvious political dimension of 02-380 is the "telecom industry depression" in which stock prices of major telecommunications service providers and equipment vendors continue to spiral downward and several flirt with or have already entered bankruptcy and dissolution, and consumer and investor confidence having completely vanished. The naked truth of the "telecomm industry depression" is that there is almost nothing the FCC, or the entire US Government can do to change the stark realities of rapid technological evolution that has made much of the US telecommunications infrastructure essentially obsolete. Perhaps the FCC hopes that 02-380 will be seen as significant progress in "expanding on the one portion of the telecommunications industry that *is* working”, growing measurably, and attracting new investments – “Wi-Fi” (in truth, the overall Broadband Wireless Internet Access industry, which is regularly, inappropriately plastered attributed to “Wi-Fi”.)

Lastly, the “on the surface” political dimension of 02-380 is that of an FCC coming to the conclusion that the license-exempt model of spectrum allocation has resulted in significant economic activity, new services, and technical innovation and in general should be encouraged. Despite enormous technological handicaps which include only low power transmission permitted, equipment certification regulations intended largely for devices such as garage door openers, portions of spectrum not particularly well suited for outdoor usage… a successful industry has emerged to provide Broadband Internet Access via license-exempt spectrum.

> An Internet Service Provider industry based on license-exempt spectrum shouldn’t have had a chance to emerge. The FCC expected that a number of exclusive, licensed spectrum allocations such as WCS (2.3 GHz), MMDS (2.5-2.7 GHz), and LMDS (28 GHz) would result in widespread, competitive Broadband Internet Access services being offered via wireless. For reasons too numerous and detailed to examine in this article, competitive Broadband Internet Access services have generally not emerged from use of licensed spectrum. There is some reason to hope that such service may yet emerge… but not *much* hope. (An in-depth analysis of this topic will likely appear in a future issue of

The most glaring lack in the use of license-exempt spectrum is that the most popular band – 2.4 GHz, has very poor foliage penetration characteristics… 2.4 GHz signals generally don’t penetrate through trees. The foliage penetration characteristics of 5.8 GHz are even worse than that of 2.4 GHz. In a strategic gamble that has proven to be successful, WaveRider Communications was the first Broadband Wireless Internet Access vendor to make use of the much better foliage penetration characteristics of the 902-928 MHz license-exempt band. WaveRider has been so successful that it has attracted at least one, and likely several competitive vendors to begin offering products for 902-928 MHz.

But… 902-928 MHz is only 26 MHz of spectrum, in an era where a Wi-Fi “channel is 22 MHz wide that delivers 11 Mbps of “raw” communications bandwidth.

Two-Way Radio Use A Minor Complication

One complication to my suggestion is that in thirteen metropolitan areas, one or two Channels between Channel 14 and Channel 20 are in use for two-way radio communications; an embedded “TV tuner” would not detect such usage.”

Comments To Date Are Sparse

While comments on this NOI to date have been light, one prime reason is the crush of the US Holiday Season.

I expect comments to this NOI to be highly favorable to the FCC’s proposal. Geographically (few television transmitters in rural areas) and spectrally (500 MHz offers very good range and foliage penetration characteristics), television broadcast spectrum is especially well-suited for use in secondary markets and rural areas. The FCC clearly feels that current regulations for license-exempt spectrum operations are a good fit for television broadcasting spectrum as long as a technical solutions can be established for insuring non-interference with existing and new television broadcasting (if a new transmitter starts up, license-exempt users “vacate” the newly-occupied channel.)

Many Vendors Have Near-Term Products

It will likely surprise the FCC to find out just how many Broadband Wireless Internet Access equipment vendors could rapidly adapt existing products to take advantage of license-exempt use of television broadcast spectrum. For example:

- WaveRider could adapt their existing 902-928 MHz Last Mile Solution product to operate lower in the spectrum. The LMS uses Direct Sequence Spread Spectrum whose channel would fit comfortably within a 6 MHz television channel.
- Aperto Networks PacketWave system was designed to use 6 MHz channels, achieving bandwidth of up to 20 Mbps. PacketWave

is modular with an externally mounted radio for the spectrum of choice- currently MMDS, 3.5 GHz, or 5 GHz. Aperto need only design a new external unit to make use of television broadcast spectrum.

- Clearwire Equipment has developed a Broadband Wireless Internet Access Software-defined Radio that requires very little customization to operate in nearly any portion of spectrum below 3 GHz.

* * *

Events Of Interest To The Broadband Wireless Internet Access Industry

Please let me know of events that will be of interest to those in the Broadband Wireless Internet Access industry, and they will be featured as space permits. If I plan to attend a particular Event, it is noted.

- January 12, 2003 – San Jose, CA – Wireless Communications Association International (WCA) Technical Symposium & Business Expo – "Rising To the Challenge in Broadband…" (Numerous pre-show activities)
  www.wcai.com/event/ts9general.htm
  I will attend this event.
- January 13-15, 2003 – San Jose, CA – Wireless Communications Association International (WCA) Technical Symposium & Business Expo – "Rising To the Challenge in Broadband…"
  www.wcai.com/event/ts9general.htm
  I will attend and speak at this event.
- January 13-15, 2003 – San Jose, CA – IEEE 802.16 Working Group on Broadband Wireless Access Standards Session 23 (held in conjunction with WCA Technical Symposium & Business Expo)
  grouper.ieee.org/groups/802/16/meetings/mtg23/index.html
  I will attend this event
- February 25-16, 2003 – St. Louis, MO – 700 MHz User's Group Networking & Educational Conference 2003
  www.scievents.com/700users
- March 1, 2003 – Stanford, CA – Spectrum Policy: Property or Commons?
  cyberlaw.stanford.edu/spectrum
- March 6-7, 2003 – San Jose, CA – Software Defined Radio Investment Opportunities
  www.scievents.com/sdr
- March 9-14, 2003 – Dallas / Fort Worth, TX – IEEE 802.16 Working Group on Broadband Wireless Access Standards Session 24 (held in conjunction with IEEE 802 Plenary Session)
  ieee802.org/meeting/meeting files/802-303-MI-03.html
- March 11-12, 2003 – Amsterdam, Netherlands – WLAN Congress
  www.ibctelecoms.com/cr1705
- March 14, 2003 – Tokyo, Japan – 802.11 Planet Conference and Expo Japan 2003
  www.jupiterevents.com/80211/tokyo03
- March 17-19, 2003 – New Orleans, LA – CTIA Wireless 2003
  www.wireless2003.com
- March 16-20, 2003 – New Orleans, LA – IEEE Wireless Communications & Network Conference 2003 (held in conjunction with CTIA Wireless 2003)
  hwww.wcnc.org
- March 23, 2003 – Chicago (Oak Brook) IL – Wireless ISP Conference – WISPCON III (Numerous pre-show activities)
  www.wispcon.info/US/WISPCON III/WISPCON-III.htm
  I plan to attend and speak at this event.
- March 24-26, 2003 – Chicago (Oak Brook) IL – Wireless ISP Conference – WISPCON III
  www.wispcon.info/US/WISPCON III/WISPCON-III.htm
  I plan to attend this event.
- April 9-10, 2003 – San Jose, CA – Broadband Wireless World 2003
  www.scievents.com/bwwf03
- April 15-16, 2003 – Shanghai, China – Wireless China 2003
  http://infoexevents.com/wireless/
- April 21-23, 2003 – Frankfurt, Germany – WISPCON-EURO
  www.wispcon.info
  I will attend and speak at this event
- April 27 – May 2, 2003 – Las Vegas, NV – NETWORLD + INTEROP Las Vegas
  www.interop.com
- May 12-15, 2003 – Singapore – IEEE 802.16 Working Group on Broadband Wireless Access Standards Session 25 (held in conjunction with the other IEEE 802 Wireless Working Groups meetings)
  grouper.ieee.org/groups/802/16/meetings/mtg25/index.html
- June/July, 2003 – Sydney, Australia or Auckland, New Zealand – WISPCON Pacific
  www.wispcon.info

- June 1-5, 2003 – Atlanta, GA – SUPERCOMM 2003 `www.supercomm2003.com`
- June 24-25, 2003 – Vienna, Austria - Broadband Wireless Europe 2003 `www.scievents.com/bwe03`
- June 25-27, 2003 – Boston, MA – 802.11 Planet Conference & Expo Spring 2003 `http://www.jupiterevents.com/80211/spring03/index.html`
- July 21-24, 2003 – San Francisco, CA - IEEE 802.16 Working Group on Broadband Wireless Access Standards Session 26 (held in conjunction with IEEE 802 Plenary Session) `ieee802.org/meeting/future_meetings.html`
- August 10-13, 2003 – Boston, MA - IEEE Radio and Wireless Conference (RAWCON) `www.rawcon.org`
- September, 2003 – Hong Kong – Broadband Wireless Asia 2003 `www.scievents.com/bwasia`
- September, 2003 – Washington, DC – WISP.X Wireless ISP Conference & Expo `www.scievents.com/wispx`
- September 8-11 *or* September 15-18, 2003 – *Site To Be Determined* – IEEE Working Group on Broadband Wireless Access Standards Session 27 (held in conjunction with IEEE 802 Plenary Session) `grouper.ieee.org/groups/802/16/calendar.html`
- September 18-19, 2003 – Sydney, Australia – 802.11 Planet Conference & Expo Australia 2003 `www.jupiterevents.com/80211/sydney03`
- September 29-30, 2003 – Munich, Germany – 802.11 Planet Conference & Expo Europe 2003 `www.jupiterevents.com/80211/munich03`
- November 9-14, 2003 – Albuquerque, NM – IEEE Working Group on Broadband Wireless Access Standards Session 28 (held in conjunction with IEEE 802 Plenary Session) `ieee802.org/meeting/future_meetings.html`
- December 9-11, 2003 – Santa Clara, CA – 802.11 Planet Conference & Expo Fall 2003 `www.jupiterevents.com/80211/fall03`
- January 12-15, 2004 – Vancouver, BC – IEEE 802.16 Working Group on Broadband Wireless Access Standards Session 29 (held in conjunction with the other IEEE 802 Wireless Working Groups meetings) `grouper.ieee.org/groups/802/16/calendar.html`

With Thanks To…

As an *Independent* Technology Writer, I don't have access to the resources of large news and publishing organizations. What I do have are a number of people I've found over the years that offer high quality information that is highly relevant to the content of ***FOCUS***, at no cost. Such "free" content providers don't get thanked nearly often enough, and, as a regular feature of ***FOCUS***, I'd like to acknowledge their efforts:

- Broadband Wireless Business Magazine / Broadband Wireless Weekly Report `www.shorecliffcommunications.com/magazine/default.asp`
- Broadband Wireless Exchange Magazine `www.bbwexchange.com`
- Dana Blankenhorn – A-Clue.com `www.a-clue.com`
- David Farber – Interesting-People List `www.interesting-people.org`
- Glenn Fleishman – Wi-Fi Networking News `wi-fi.weblogger.com`
- Jim Geier – Wireless Nets Newsletter `www.wireless-nets.com`
- Dewayne Hendricks – Dewayne-Net Technology List `www.warpspeed.com`
- David Isenberg – The SMART List `www.isen.com`
- Open Spectrum `www.tinyurl.com/45d5`
- Part-15.Org `www.part-15.org`
- Alan Reiter – Reiter's Wireless Data Web Log `reiter.weblogger.com`
- Wireless Communications Association International (WCA) – WCA Weekly Bulletin (members only) `www.wcai.com`

* * *

***FOCUS** On Broadband Wireless Internet Access* is
Copyright © 2001-2003
by Steven K. Stroh.
All Rights Reserved.
This publication may not be reproduced or distributed in any way without the express written consent of Steven K. Stroh.

FOCUS

On Broadband Wireless Internet Access

Steve Stroh, Editor
www.strohpub.com/focus.htm

Subscription Form

To subscribe to ***FOCUS***, please print, fill out, and mail this form with your payment.

Name: Company (if applicable):

Address: Dept/ Routing Code (if applicable):

City / State or Province / Postal Routing Code / Country:

Phone number: email address:

Please provide a brief description of how you learned of ***FOCUS,*** what your particular interest is in subscribing to ***FOCUS***, and any comments or suggestions. *Thanks!*

Pricing:
A one year subscription (44 issues) to ***FOCUS*** is $595.00. A substantial discount is available for Independent Press and Students. Please contact us for details.

Payment:
Currently, we are currently able to accept only corporate or personal checks, payable to Steve Stroh, in US funds. We do accept Purchase Orders, and will generate a corresponding invoice for a one-year subscription within a few days of receiving a P.O. We expect to have the ability to accept credit card payments and conduct ecommerce, likely via PayPal, in the near future. Please mail your check (via postal mail or Fedex only; *UPS, Airborne, etc. will not deliver to this address*) to:

Steve Stroh
P.O. Box 84
Redmond, WA 98073-0084 USA

Delivery:
The primary method of delivery will be an Adobe Acrobat (.pdf) file sent via email. Arrangements can be made for hardcopy versions for an additional cost. Please contact us for details.

Customer Service:

email: focus@strohpub.com Phone: 425-481-0600

An online version of this form can be found at www.strohpub.com/focussub.pdf